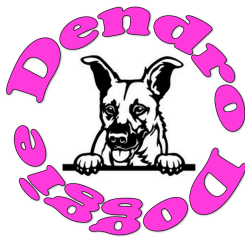


# CS486C – Senior Capstone Design in Computer Science

## Project Description

**DendroDoggie** – A tablet app to streamline data acquisition and visualization from the TOMST point dendrometer mini-logger



### Sponsor Information:

Prof. Andrew Richardson, SICCS/ECOSS

([Andrew.Richardson@nau.edu](mailto:Andrew.Richardson@nau.edu))

Prof. Mariah Carbone, ECOSS ([Mariah.Carbone@nau.edu](mailto:Mariah.Carbone@nau.edu))

Prof. George Koch, ECOSS ([George.Koch@nau.edu](mailto:George.Koch@nau.edu))

Austin Simonpietri, ECOSS ([ats327@nau.edu](mailto:ats327@nau.edu))

**ECOS<sup>S</sup>** Center for Ecosystem  
Science and Society at  
Northern Arizona University

### Project Overview:

Trees record the history of their growth in their annual rings. But have you ever wondered, “when does a tree grow?”

Do trees grow in the spring? summer? autumn? During the day or at night? When it's warm or cool? Wet or dry?

This Capstone Team will develop a tablet app that helps to answer these questions!

A miniaturized instrument—called a **dendrometer** (**dendro-** for tree and **-meter** for a measuring device)—developed by the TOMST company in the Czech Republic enables automated and continuous measurements (every 30 minutes, day after day, year after year) of changes in a tree's diameter. These changes in diameter are driven by tree growth, as well as shrinking and swelling of the trunk as water availability changes.

Data collected with TOMST dendrometers is providing ecologists and tree physiologists at NAU, in the Center for Ecosystem Science and Society, and the School of Informatics, Computing and Cybersystems, with information about when trees across the western US are growing. For example, Profs. Koch and Richardson have been installing TOMST dendrometers at the top of towering coast redwood trees in California. Prof. Carbone and PhD student



Left: miniature TOMST dendrometer. Right: Prof. Koch installing a dendrometer at the top of a 300' high coast redwood in California.

Simonpietri have been studying the growth of aspen and spruce trees near treeline in Colorado.

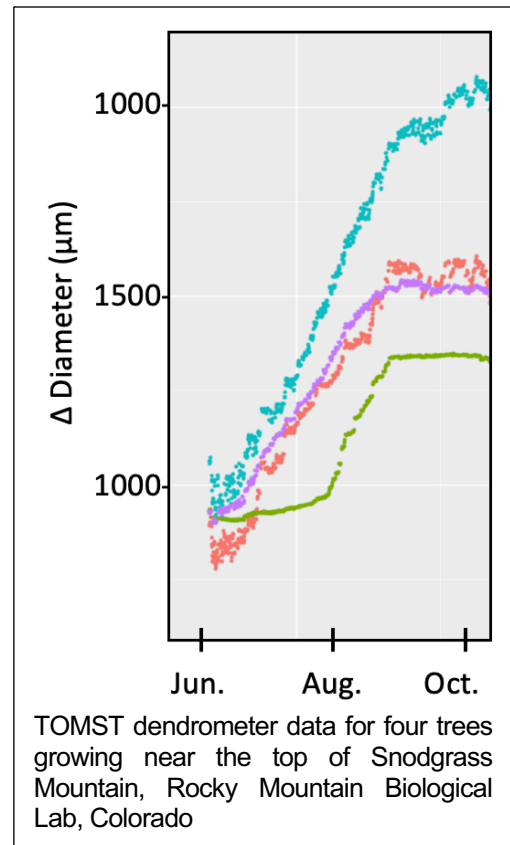
But, an outstanding challenge for both of these research projects is that downloading data from the TOMST dendrometer requires a heavy laptop computer running the Windows OS. Carrying a laptop to treeline is inconvenient, but hauling one to the top of a redwood tree is another matter entirely. The limitations of the current system include:

- The laptop is heavy and fragile and not suited to field use in wet and windy environments
- The laptop requires two hands for operation
- The software is buggy
- The software has limited functionality and does not organize data in a useful way
- The software does not allow integration of dendrometer data with metadata (e.g. photos, GPS location information, etc.)

The project Sponsors seek a motivated and creative Capstone Team to lead development of the “DendroDoggie” tablet app which will overcome the limitations of the current PC-based system, facilitating data collection in the field and opening up new opportunities to use TOMST dendrometers in remote locations with difficult access. The dog in the project logo is an Australian cattle dog, because the app will enable the user to “round up” dendrometer data. This project follows in the paw prints of the highly successful “FluxPuppy” capstone project (2018-2019), which led to the development of a similar tablet app for carbon dioxide flux monitoring (<https://phys.org/news/2019-05-flux-puppy-ecological-app-carbon.html>), and a peer-reviewed publication with capstone team members (<https://tinyurl.com/fluxpuppy>).

Some key features of the DendroDoggie app will include:

- One-handed operation
- Definition of “site clusters” (multiple dendrometers at a site) and alignment/integration of data from dendrometers at that site into a single master file
- Plotting capacity (change in diameter over time, with the option of overlaying data from multiple dendrometers at a site on the same graph)
- Statistical analysis of dendrometers within a site cluster (which trees are growing similarly and which are different?)
- Metadata for each site cluster and each dendrometer (GPS location pulled from tablet, option to record photographs of each dendrometer installation, field notes on tree size and location in tree, etc.)
- Export of data to cloud services (Google Sheets, Gmail, DropBox, etc.)



**Impact of successful product:**

A successful project will lead to a robust, easy-to-use table application that will be shared with researchers at NAU (TOMST dendrometers will be used in three new \$1m projects, one in each of Ecosystems, SICCS, and Forestry) as well as collaborators at other institutions (e.g. Oregon State, University of Illinois, University of Arizona). The app will be shared with the broader scientific community through a poster presentation at a national conference or a peer-reviewed journal publication, which will include the DendroDoggie team as coauthors. Finally, the app will be shared with TOMST, potentially leading to use of the app by researchers around the world.

**Knowledge, skills, and expertise required for this project:**

- Interest in forestry, ecology or biology
- Knowledge of tablet app development
- Basic statistical understanding
- Understanding of communications protocols

**Equipment Requirements:**

- The sponsors will provide the DendroDoggie team with a tablet, TOMST dendrometer, and TOMST communication cables/dongle
- The sponsors will connect the team with the software development team from TOMST, who are willing to assist with understanding communication protocols, etc.
- There should be no additional equipment or software required other than a development platform and software/tools freely available online.

**Software and other Deliverables:**

- A strong as-built report detailing the design and implementation of the product in a complete, clear and professional manner. This document should provide a strong basis for future development of the product.
- Complete professionally-documented codebase, delivered both as a repository in GitHub, BitBucket, or some other version control repository; and as a physical archive on a USB drive.
- In-person demonstration of the app's functionality